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Jigat Production Potential of Few Cultivated Plant Species for Agarbathi Industry

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Abstract

Jigat production potential of five cultivated plant species was studied for preparation of agarbathi. Of which *Hibiscus rosa sinensis* L, *Manihot esculenta* Crantz, *Morus alba* L are three shrub species and *Corchorus capsularis* L. and *Ipomoea batatas* (L.) LAM. are herbs. Tender branch tips of *Hibiscus rosa sinensis*, *Manihot esculenta*, *Morus alba* and entire aerial part of *Ipomoea batatas* and two months field grown *Corchorus capsularis* were harvested and dried in sun separately. The dried samples were grinded into fine particles and sieved through 100 mesh sieve. The powder obtained from each plant species were studied for binding ability to prepare agarbathi as alternative Jigat powder (AJP). The experiment was also conducted for preparation of agarbathi by making a mixture of the above fives in three different ratios and compared with a commercial Jigat. Agarbathi prepared from AJP of each plant species or the mixture were further evaluated for burning ability, burning time, odor produce during burning, shelf-life were studies subjected to quality testing as per bureau of Indian standard (BIS). The observations reveals that binding substance obtained from plant parts of all the five plant species were suitable at the ratio of 1:3 for hand rolled and 1:4 for machine rolled agarbathi production as substitute to Jigat alone or in combinations.

Keywords: binding substance, Jigat, plant species, agarbathi

Introduction

Jigat is a binding substance for filler materials or masala use to roll over the bamboo stick to make incense sticks for agarbathi industry. Jigat is a vernacular word meaning “sticky” that is used in the Karnataka, India. Since past, the agarbathi makers traditionally extracted from bark of *Michilus macrantha* and produce Jigat in Central part of India. The bark of other plant species such as *Canarium strictum, Litsea glutinosa, Boswellia serrata, Microcos paniculata, Holarrhena antidysenterica* and *Ailanthus malabarica* were later added by the communities for preparation of Jigat. The resin from *Ailanthus triphysa, Acacia farnaciana, Myroxylon toluifera, Boswellia sarata,* glues and gum from *Acacia nilotica* etc. are now found to utilized as binding materials by the agarbathi industry (Hazarika et al 2018; Lemenih, et al., 2004; Murugesan et al., 2011). Extraction of barks of *Litsea chinensis Syn. L. glutinosa* in central India and *Machilus macarantha* in tropical wet evergreen forests of Coorg and Maland district in Karnataka was reported to have caused death of a large number of trees (Prasad and Bhatnagar, 1991; Parmeshwarappa, 1992). Increasing demand for Jigat due to the extension of agarbathi industry in India has caused unsystematic felling of Jigat producing trees of the evergreen and semi-evergreen forests of Western Ghats and northeast India (Rana and Gera, 2005).

The agarbathi industry of India has been in search of substitute to Jigat powder or binding agent with unique burning properties. Presently, the industries have to import more than 50 percent of Jigat namely Joss powder or its raw materials from Malyasia, Vietnum and Thailand (Hazarika et al, 2018). Apart from this, Indian agarbathi industry is importing round bamboo sticks and raw agarbathis (without perfume) worth nearly `800 crore per year (Vishnoi, 2019).

Very scanty scientific works has so far been done to promote incense sticks industry at regional or national level. Consequently, there is a need of scientific investigation to explore more plant species that are suitable for production of binder material as substitute to Jigat for agarbathi industry of India. It will not only reduce threat on Jigat producing plant species but also could reduce capital flow and open up more livelihoods to the farmers. The flora Northeast India is rich in biodiversity and remained unexplored for natural plant based substitute to Jigat for agarbathi. Keeping in view of the above this work was taken up to screen the potential plant species for suitable substitute of Jigat for incense sticks industries of India and abroad. Therefore, five cultivated plant species of the region having mucilage properties in their leaves were investigated for their potential to utilize as substitute to Jigat for this purpose. Onggok starch powder is made in Vietnam from residual starch of the roots of *Manihot esculenta* (tapioca) and used for making agarbathi and mosquito coils. Similarly, tubers of *Ipomoea batatas* (sweet potato) also rich source of starch and both the plant species are being cultivated for food as well as biodiesel/ ethanol production (Putri, et al., 2012; Ikwebe & Harvey, 2017). However, the above ground parts like tender tips and leaves of tapioca and sweet potato also possess mucilage and are not being explored. It also reported that leaves of *Hibiscus rosa sinensis* contain mucilage (Anjaria et al., 2002; Ross, 1999). Moreover, plant species like *Morus alba* and *Corchorus capsularis* were reported to have the mucilage in tender shoots and leaves (Katayama et al., 2008; Olivier et al, 2017). The objective of this work is to evaluate potentiality of leaves, young shoots and above ground part of these plant species for production of substitute to Jigat for quality agarbathi.

Materials and Methods

The young shoots of *Hibiscus rosa sinensis*, *Manihot esculenta*, *Morus alba*, *Corchorus capsularis* and above ground part of *Ipomoea batatas* were collected and sopped into small sized. These samples were dried in Hot Air Oven at 60^0C or in sun for until it loss almost 80% moistures. In sunny days the plant materials may be dried in sun. For rapid drying plant samples may be dried in roofing sheet made of tin. Drying of samples up to 80% of their moisture content retains the required properties of the samples as they possess in raw forms. The dried samples were grinded to the finest particles using grinder. The grinded samples were sieved finally through 100 µm sieve. The samples were then stored in air tight containers to avoid damage or any fungal attack and were used as alternative Jigat powders (AJPs).

These powdered forms of samples or AJPs obtained from each of the 5 plant species alone or in combinations were investigated for their binding efficacy mixing with filler materials in different ratios and combinations to prepare ‘masala’ for making agarbathi.

The agarbathi ‘masala’ which is a mixture of alternative Jigat powder (AJP), charcoal & the saw dust was prepared separately for each of the five plant species. Moreover, a combination 1:1 mixture of all the five AJPs was also tested. Charcoal and saw dusts are known as filer materials. Charcoal powder was prepared from *Bamboo* spp. The saw dusts used for the experiment were obtained from sawmill. Both charcoal and saw dusts were oven dried at 70^0C for 6 hrs before grinding. Then grinded and finely sieved through 100 mesh sieve. The charcoal and saw dust were mixed in 1:1, 1:2 and 1:3 ratios to get different filler materials. The experiment was conducted with masala prepared in different ratio of alternative Jigat powder (AJP) and filler materials for hand rolled and machine agarbathi such as 1:2, 1:3 and 1:4. Adequate amount of water was added to get the paste of ‘masala’. Thereafter, coating of ‘masala’ on the bamboo stick was done by rolling over a small amount of the paste of ‘masala’ with the help of palm which in turn got adhered on the surface of the bamboo stick uniformly for hand rolled agarbathi. Agarbathi was also prepared using agarbathi machine of the same combinations shown in figure 2. The 8 inches long of bamboo sticks were used to prepare agarbathi. Of which, the length of 6.5 inches was covered by the filler material. A commercial Jigat was used as control for comparing the efficacy of the AJPs obtained from experimental plant species. Agarbathis thus prepared were sun dried for 2 days or to be kept in hot air oven at 60º C for 3 hours for drying the incense sticks. For this also hot air oven is preferred as naturally dried

sticks seem to be fungal affected. The dried incense sticks were treated subsequently with aromatic patchouli oil and kept for an hour or two to dry in shade condition. A schematic representation of the entire process involve in making of agarbathi is given in figure-1.

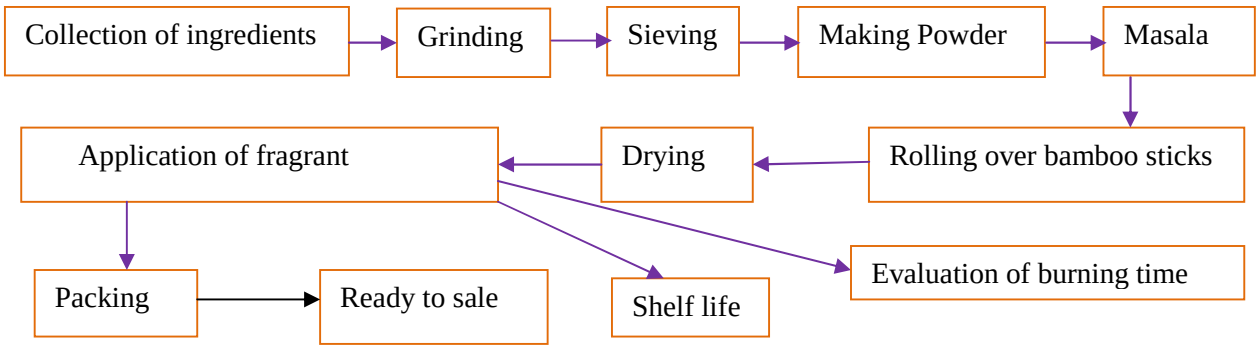


Fig- 1 Diagrammatic sketch of entire process involves in preparation of agarbathi

After that the agarbathi were packeted and kept to observe for its adhesiveness & shelf life. Storing and throwing were also done to determine stickiness and suitability of agarbathi for transportation. During the experiments observations such as stickiness of AJPs while prepared agarbathi masala with different ratio to determined optimum ratio, burning ability and continual burning of prepared agarbathi, length of burning time, quantity of aroma/scanted liquid absorbed and odor produces while burning were made. The optimum ratio of alternative Jigat powders (AJPs) obtained from each plant species was determined based on ocular observations such as binding ability of AJP, texture of agarbathi, braking and cracking while drying, throwing and during storage. The burning ability and continual burning of prepared agarbathi, length of burning time were determined by continuous observation during conduct of burning tests. A stopwatch was used to determined time of burning. Agarbattis of equal length and weight were taken to conduct these experiments. Fragrance or aromatic liquid absorbed by such agarbathi sticks for unit time was also recorded. For this *Pogostemon cabline* (patchouli) oil was used. A sensory evaluation on odor produced at the time of burning before and after application of fragrance was conducted for getting scores for agarbathi produced from each AJPs. The average score of 5 persons were recorded on 1-10 point range table to determine the odor quality of agarbathi due to AJP.

Results and Discussion

The photographs of the plant species from which the samples were collected to evaluate suitability for preparation of alternative Jigat powder are presented in the fig. 2. While conduction the experiment for evaluation of suitability of AJP of each plant species, it was observed that up to 1:3 ratio (AJP: filler) can be mixed to get suitable agarbathi masala for hand rolled agarbathi. Agarbathi thus prepared are shown in the fig 3. Similarly, it was also observed that efficacy of AJPs can be increased up to the dilution of 1:4(AJP: filler) ratio for making masala in term of smooth and unbroken quality agarbathi by using agarbathi machine (Table 1). Beyond these two dilutions of AJP and filler, the agarbathi binding capacity of the AJPs was observed to reduce and texture and smoothness also found to detoriat. Consequently the agarbathis thus produced higher than 1:3 for hand rolled and 1:4 in case of machine making were found unsuitable as they were also partially broken during storage and transportation. Scores of sensory test such as odor produced at the time of burning the agarbathis before and after application of fragrance were presented in table 1. It was observed that sensory score of agarbathi produced with AJP of plant species i.e. *Morus alba*, *Ipomoea batatas and Manihot esculenta* were equally good to the odor produced by the agarbathi made using commercial Jigat. However, sensory average score of odor produced from agarbathi made from AJP of *Hibiscus rosa sinensis* was only 7 out of 10. The sensory score for agarbathis made AJP of *Corchorus capsularis* was 9 out of 10. Most importantly, the composite AJP obtained by mixing 1:1 ratio of five plant species AJPs was recorded as good as the commercial Jigat in all respect. As such odor produce by the AJP of *Hibiscus rosa sinensis* can be rectified and may be a substitute for this combination. It was observed that the quantity of aromatic liquid absorbed by the agarbathi made from different AJPs varied and depended on weight of the agarbathi and ratio of filler use. It was observed that quantity of absorption of

fragrance liquid increased with the increase of filler quantity for hand rolled agarbathi. However, the factor was inversely proportional in case of machine made agarbathi. Data on evaluation of binding property and suitability to use as alternative to Jigat (AJPs) revealed that all the agarbathi are equally good with respect to the shelf life up to 90 days of storage after application of fragrance except agarbathi prepared from AJP of *Manihot esculenta* young shoot. It was observed that agarbathi produced using AJP of *M. esculenta* after 60 days of application of fragrance liquid was observed to crack in 20 % sticks. However, shelf life of all the agarbathi without application fragrance liquid was more than even six months at normal room condition. Over and above, burning time of these agarbathis was almost at par with the commercial Jigat. Among them agarbathi produced by using composite AJP showed best result with burning time 60 min and *Manihot esculenta* Crantz was less with 47 min burning time. Consequent observation revealed that the burning time of agarbathi prepared with AJP of *Corchorus capsularis* was 62 min that even2 min more than burning time of agarbathi made by using commercial Jigat.

Manihot esculenta Crantz

Corchorus capsularis L.

Morus alba L.

Hibiscus rosa sinensis L

Ipomoea batatas (L.) LAM.

Preparation of hand rolled agarbathi

Fig- 2 Plant species utilized for preparation of alternative Jigat Powder (AJP) to make agarbathi**.**

Drying of plant samples

Grinding of dried samples

Sieving of grinded alternative Jigat powder (AJP)

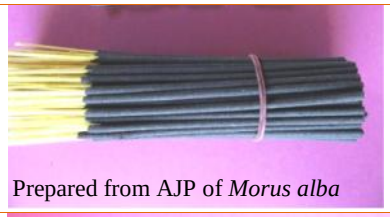
Making of Agarbathi using machine

Prepared agarbathis with filler & AJP

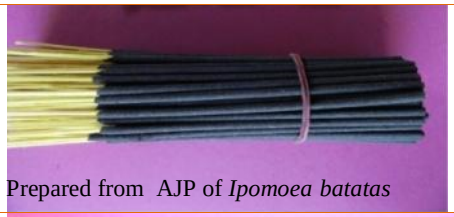
Prepared hand rolled agarbathis

Prepared machine made agarbathis

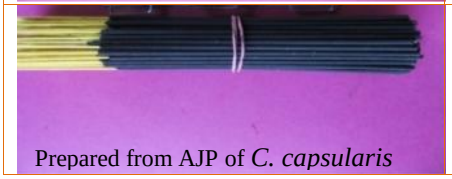
Prepared from AJP of *H. rosa sinensis*



Prepared from AJP of *Morus alba*

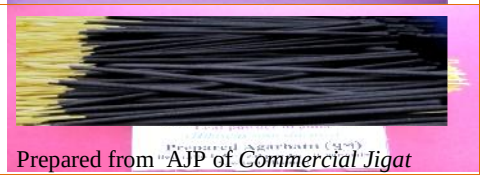


Prepared from AJP of *Ipomoea batatas*



Prepared from AJP of *C. capsularis*

Prepared from AJP of *M. esculenta*



Prepared from AJP of *Commercial Jigat*

Fig -3 Agarbathis prepared from AJPs of five plant species along with a few moments of processing and making of agarbathi

Table 1 Parameter studies before and application of fragrance to the best ratio of alternative to Jigat Powder (AJP) for evaluation of suitability

Name	Parameters studied					
	Best ratio (AJP: filler)	Uniformity & Texture of Agarbathi	Burning ability	Sensory score (1-10) burning odor		Quantity of Aromatic liquid absorbed (ml/stick)
				Before*	After*	
Commercial Jigat (CJ)	1:3 for hand rolled	Best & Smooth^{+++}	Uniformly burnt	10	10	0.32
	1:4 for Machine	Best & Smooth^{+++}	Uniformly burnt	10	10	0. 25
Hibiscus rosa sinensis L	1:3 for hand rolled	Good & Smooth^{+}	Uniformly burnt	7	7	0.46
	1:4 for Machine	Best & Smooth^{+++}	Uniformly burnt	7	7	0.42
Ipomoea batatas (L) Lam	1:3 for hand rolled	Best & Smooth^{+}	Uniformly burnt	10	10	0.63
	1:4 for Machine	Best & Smooth^{++}	Uniformly burnt	10	10	0.32
Manihot esculenta Crantz	1:3 for hand rolled	Good & Smooth^{+}	Uniformly burnt	10	10	0.63
	1:4 for Machine	Good & Smooth^{++}	Uniformly burnt	10	10	0.39
Corchorus capsularis L	1:3 for hand rolled	Best & Smooth^{++}	Uniformly burnt	9	9	0.31
	1:4 for Machine	Best & Smooth^{+++}	Uniformly burnt	9	9	0.35
Morus alba L	1:3 for hand rolled	Good & Smooth^{++}	Uniformly burnt	10	10	0.36
	1:4 for Machine	Good & Smooth^{++}	Uniformly burnt	10	10	0. 33
Composite sample	1:3 for hand rolled	Best & Smooth^{++}	Uniformly burnt	10	10	0.49
	1:4 for Machine	Best & Smooth^{+++}	Uniformly burnt	10	10	0.34

*Application of fragrance

Table 2 Evaluation of binding property and suitability to use as alternative Jigat

Name	Observation	Parameters studied							
		Binding Quality	**Agarbathi Texture** (%)	**Burning ability** (after drying)	**Burning time** (Min)	**Moisture absorption in storage**	**Loss of Stickiness in storage**	**Changes / Microbial growth**	**Transporting Suitability**
Commercial Jigat (CJ)	30 days	best	smooth	consistent	60	No	No	No	Suitable
	60 days	best	smooth	consistent	58	No	No	No	
	90 days	best	smooth	consistent	52	No	No	No	
Hibiscus rosa sinensis L	30 days	best	smooth	consistent	59	No	No	No	
	60 days	intact	intact	consistent	49	No	No	No	Suitable
	90 days	intact	intact	consistent	50	No	No	No	
Ipomoea batatas (L) Lam	30 days	Good	Smooth	consistent	47	No	No	No	Suitable
	60 days	intact	intact	consistent	49	No	No	No	
	90 days	intact	intact	consistent	49	No	No	No	
Manihot esculenta Crantz	30 days	Good	Smooth	consistent	46	No	No	No	Suitable
	60 days	intact	intact	consistent	47	No	No	No	
	90 days	intact	intact	consistent	47	No		No	
Corchorus capsularis L	30 days	Good	Smooth	consistent	60	No	No	No	
	60 days	intact	intact	consistent	60	No	No	No	
	90 days	intact	intact	consistent	62	No	No	No	Suitable
Morus alba L.	30 days	Good	Smooth	consistent	58	No	No	No	
	60 days	intact	intact	consistent	55	No	No	No	Suitable
	90 days	intact	intact	consistent	50	No	No	No	
Composite sample	30 days	Good	Smooth	consistent	58	No	No	No	
	60 days	intact	intact	consistent	60	No	No	No	Suitable
	90 days	intact	intact	consistent	60	No	No	No	

Conclusion

The smog and Carbon monoxide produce during burning by the agarbathi due to use these AJPs were not able determined due to lack of handy instruments and technique. Determination of these two parameters is now considered quite important in perspective of global warming and climate change. However, from the above observances and finding it can be concluded that all these plant species can contribute quality product to substitute the Jigat and thus can eliminate the increasing pressure of the plant species such as *Machilus macarantha*, L. *glutinosa* etc. More importantly plant species like *Hibiscus rosa sinensis*, *Manihot esculenta* and *Morus alba* can be propagated and grown easily from tip cuttings and branch cutting etc in addition to conventional seed propagation. The roots and tubers of *Manihot esculenta* and *Ipomoea batatas* are important source of not only food but also biodiesel ethanol. *Corchorus capsularis* is widely cultivated in Indian alluvium soils for extraction of jute. All the 5 plant species are grown well in Indian climatic and adaphic condition which gives more weight on their applicability for substituting Jigat. Many a times these residual parts while crops are harvested remain unused. Therefore this piece of work benefited the farmers for enhancement of livelihood with value addition.

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